AuVi (Audio to Visual)

Our Team

Drew McCoy - *UX Designer*

Jacob Longhurst - *Design Research Analyst*

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Contribution Statement

Drew	25%	Drew sketches & storyboards; wrote design scenarios; proofread assignment
Jacob	25%	Wrote design research, themes, and problem overview; proofread assignment
Josh	25%	Came up with project name, contributed to most sections: proofread assignment
Toby	25%	Wrote task analysis; formatted and styled assignment, proofread assignment

Problem & Solution Overview

Deaf people live in a world that is unique, one without sound. This has been a source of identity, culture, and often pride for them as people. It also can be a source of frustration, as elements of our society often assume hearing when designs are made. Deaf people face unique challenges, particularly in the context of transportation. When biking, driving, and walking, there are many auditory signals that deaf people are not aware of. They cannot hear bike bells and shouts, sirens, and honking horns. They also cannot hear cars and other vehicles approaching behind them.

Our design solution gives deaf people the ability to sense auditory signals visually, allowing them to better adapt to changing circumstances while they are commuting. The design is made up of two parts: a sensory system and a notification system. The sensory system is made up of two sensors that sense audible signals and the direction they are produced from. The design then relays this information to the notification system - a special pair of glasses. Depending on the direction of the sound, LED lights embedded in the rims of the glasses turn on, alerting the user of important audible information. This design gives the deaf piece of mind knowing that they are able to detect things that could alert them of unsafe situations.

Design Research Goals, Stakeholders, and Participants

The goal of our design research was to identify the key needs of our the Deaf community, within the context of transportation. Thus, Deaf people with issues in this area formed our stakeholders. Because it is difficult to follow someone around on their daily commute, we concluded that the best research approach for our project was having a dialogue with deaf individuals and allow them to report their experiences to us. During these conversations we hoped to learn what strategies they currently use to in their day-to-day movement and what issues they ran into. We wanted to ask follow up questions about any issues they ran into to better clarify the causes of those them. Our hope was that those issues could serve as the basis for our eventual design. With this approach in mind, we conducted three different interviews. Jacob is competent in American Sign Language (ASL), so he attended an ASL meetup and interviewed two deaf people that were in attendance. One was a deaf and blind, while the other had significant hearing loss and used a hearing aid. In addition, Drew and Toby interviewed a deaf classmate, with the help of an interpreter.

Participants

Participant 1 was interviewed by Jacob an ASL meetup. She is a Resident Service Coordinator for Bellwether Housing. She has very substantial hearing loss, but can hear very loud noises through the use of a hearing aid. Her primary mode of transportation is by car, which she uses daily in her half hour commute. In addition, she occasionally goes for walks and runs for exercise. She doesn't use a bike. Jacob and her communicated primarily through sign language with some voice for particularly complicated subjects.

Participant 2 was also interviewed at an ASL meetup. Her experience is very unique - in addition to being deaf since birth, she is also partly blind. Because of this, she is unable to drive or bike. Her mode of transportation is a Metro Service called Access, a service subsidized by King County. It allows her to be picked up and dropped off for a small fee. At times when she cannot use this, she defaults to Uber. She had a very unique perspective. This reminded us to consider other intersecting disabilities when designing our final project.

Participant 3 is an undergrad in the CSE program at the UW. The interview took place in a Sieg Hall on January 29th, and and her interpreter was present. She was born hearing, but an accident at age 13 resulted in total hearing loss in her right ear and profound hearing loss in her left ear. Thus, she has a cochlear implant in her right ear and wears a hearing aid in her left ear. Participant 3 wears these devices as much as possible, primarily for environmental sounds such as loud car horns or people shouting. She lives about 25 minutes away from campus by foot or 15 minutes by bike. Weather permitting, she walks and bikes, otherwise she ubers. Participant 3 is very relatable to us as she is a peer in the CSE program and a fellow college student.

Design Research Results and Themes

Several critical themes emerged in our research. In the interviews we conducted, participants identified several problems that arise during their day-to-day navigation. Even with their current assistive devices, participants noted difficult aspects of getting around.

All three participants voiced concerns about sensing vehicles approaching from behind, both in a car and on a bicycle. Participant 2 expressed that "[she avoids] biking altogether, because not hearing cars or bikes approaching from behind makes [her] very uncomfortable." Participant 3 bikes frequently and also voiced a similar concern: "People think I'm rude when I don't let other bikers pass, even when they yell at me to let them pass." She also noted experiences where she didn't hear the honk of a car trying to pass her, which frightened her.

Another concern brought up by two of the three participants was that they couldn't sense their surroundings when walking. Participant 3 noted, despite their assistive hearing devices' help, that "while walking [she] has trouble determining the origin of loud sounds". She worries that she is not acknowledging people trying to communicate with her, as people don't always realize that she is deaf. In addition, participant 1 said that as a pedestrian, she has difficulty hearing horns and emergency vehicles until they are close enough to see.

Our research uncovered these key issues and informed the tasks that we chose to consider for our design. These are also the key tasks that our design seeks to solve.

Task Review

Who is going to use the design?

Our research suggests that our design would be used by members of the deaf and hard of hearing community that want to know what's happening around them while driving, biking, and walking in their day to day lives.

What tasks do they now perform?

Interviewees walk, bus, bike, drive, and use ride sharing services to get around. Two of three research participants noted the use of assistive listening devices (ALDs) which aid them when moving from place to place. One participant indicated that she feels forced to drive or use public transportation, as she cannot hear people around her, even with her ALDs. While driving, our participants said they were particularly attentive to their surroundings in order to stay safe while commuting.

What tasks are desired?

Our research showed that members of the Deaf community avoid certain types of transportation due to their inability to hear what is going on around them. All interviewees expressed a desire for a system that would alert them to the location of directional sounds, such as car horns, bike horns, and sirens, in order to utilize modes of transportation that they currently view as unviable.

How are the tasks learned?

Biking and walking are usually learned at a young age. Driving is often learned in the mid-teens. People who are born deaf learn to do these tasks without sound from the start. People who become deaf have to readjust to walking, biking, and driving without the auditory signals they have become accustomed to. People do this with some combination of experience, trial and error, or a guide.

Where are the tasks performed?

Our interviewees have transportation patterns that match the rest of the population. Therefore, the tasks will often be performed during their daily commute. In addition, the tasks may also be completed during other times, such as shopping, exercising, or outdoor recreation. These tasks take place in their vehicle, on their bike, or on foot.

What is the relationship between the person and data?

Each person told us about their transportation habits and the difficulties they face during those habits. Each person also noted being dissuaded from certain modes of transportation due to a lack of auditory information. They also thought that a device presenting this information could expand their currently viable modes of transportation.

What other tools does the person have?

Currently the deaf have a few viable tools to understand what is happening around them. Participants in our interviews said that they often have heightened awareness when navigating; they are constantly straining their neck to see what is happening around them. They also use mirrors to extend their vision. They also said this heightened focus on their surroundings often becomes a source of stress.

How do people communicate with each other?

While biking, driving, and walking, people mainly communicate with audio signals such as yelling, horns, and bells. There are also visual signals such as flashing lights.

How often are the tasks performed?

Commuting occurs multiple times a day to weekly, depending on the individual. People often move around much more in a day though, be it to visit friends, get lunch, or run errands. It’s worth noting that multiple issues can occur within one movement.

What are the time constraints on the tasks?

The time it takes for a person to get to their destination varies wildly from a quick jaunt down the street to cross state trips. Within these larger movements there are many moments where they need to know about a vehicle or person around them. Notifying users of these cases ranges from the nearly instantaneous (in the case of collision avoidance) to more than ten seconds (in the case of signaling the intent to pass).

What happens when things go wrong?

More common issues include longer commutes, being yelled at by frustrated people, extra stress or exhaustion due to the need for constant, heightened attention. In extreme cases injury and death can occur as a result of collisions caused by not noticing cars and bikes around you.

Proposed Design Sketches

Attachable | Proposed Design 1

Description

This design is a notification system that can be attached or installed to a vehicle. The system is made up of two sensing devices and a notification device, connecting through bluetooth. The sensors are attached on either side of the rear end of the car and use mix of ultrasonic/radar sensors and microphones. The sensors are then able to detect if another vehicle is passing them or if an emergency vehicle is behind them. The dual sensor design enables the system to pinpoint which side of the vehicle the information is coming from. The notification device is a small screen attachable screen placed on the dashboard of the vehicle. The notifications on the screen are designed to be easily understood be the user, in order to inform the user quickly while not acting as a distraction. This system can also be attached to a bike. The sensors would be placed at either side of the back of the bike, while the screen would be placed in the middle of the handle bars.The sensors can also be attached to a backpack for use while walking. The screen could then be mounted onto the users wrist to notify them of noises in the surrounding area.

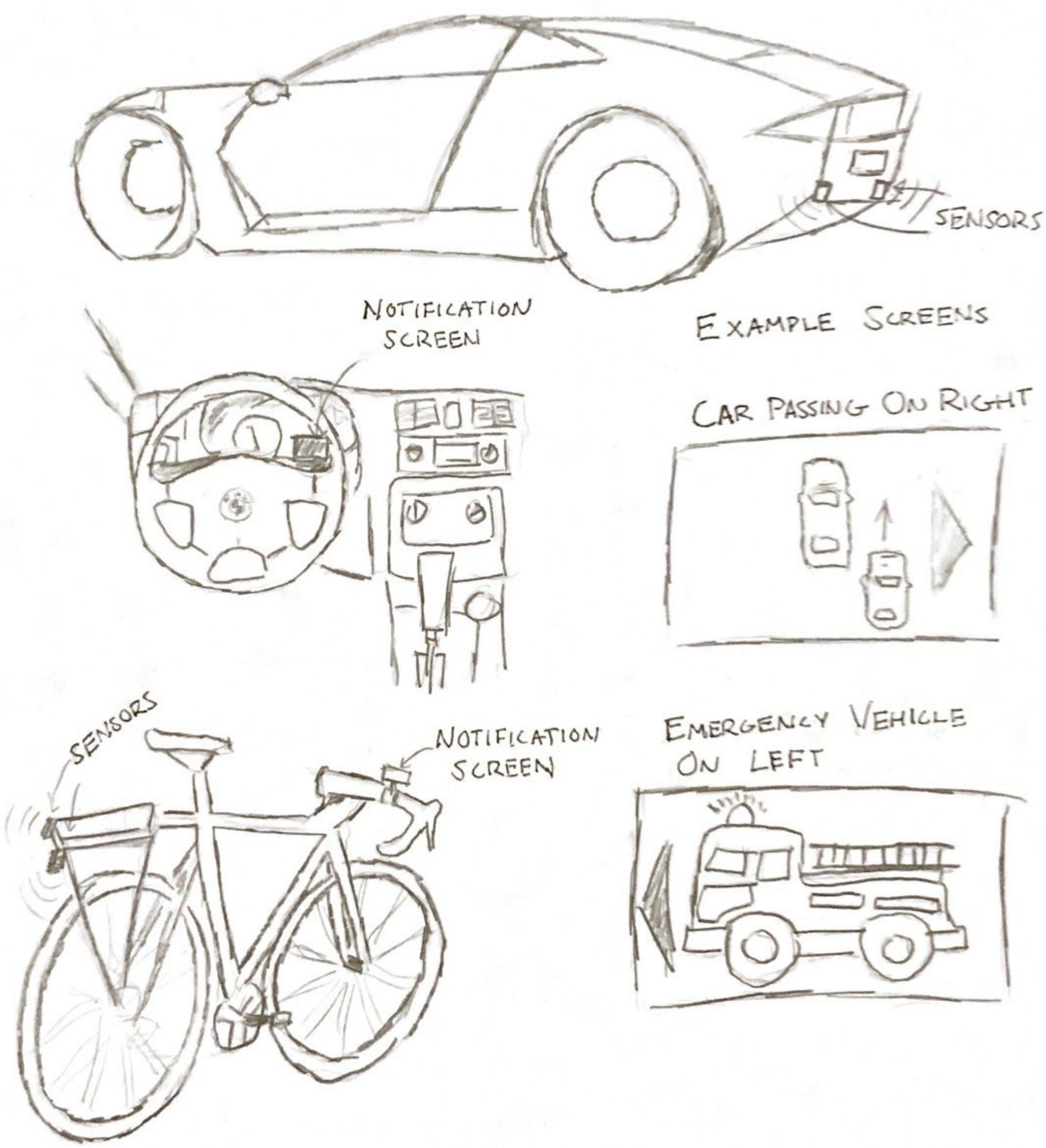
Supported Tasks

Notify bikers and drivers when someone is trying to pass them. (1)

- Alert is generated on notification device that someone is behind them

Inform user that an emergency vehicle is approaching. (2)

Sketches


SENSORS
NOTIFICATION SCREEN
EXAMPLE SCREENS
CAR PASSING ON RIGHT
SENSORS
NOTIFICATION SCREEN
EMERGENCY VEHICLE ON LEFT

Wearable | Proposed Design 2

Description

This device is worn as glasses, and is used to notify the user of audio information around them. There are microphones attached on the ends of the ear hooks that collect audio information around the person. The glasses feature a non-intrusive display on the left and right hand sides that rely the audio information as small lights around the users peripheral view. This allows the user to quickly find the source of the noise to the left, right, or behind. In addition, the glasses also support differentiation between passing vehicles and very loud or high frequency noises, such as an ambulance siren or a car horn.
Sketches

Tasks Supported

Notify bikers and drivers when someone is trying to pass them. (1)

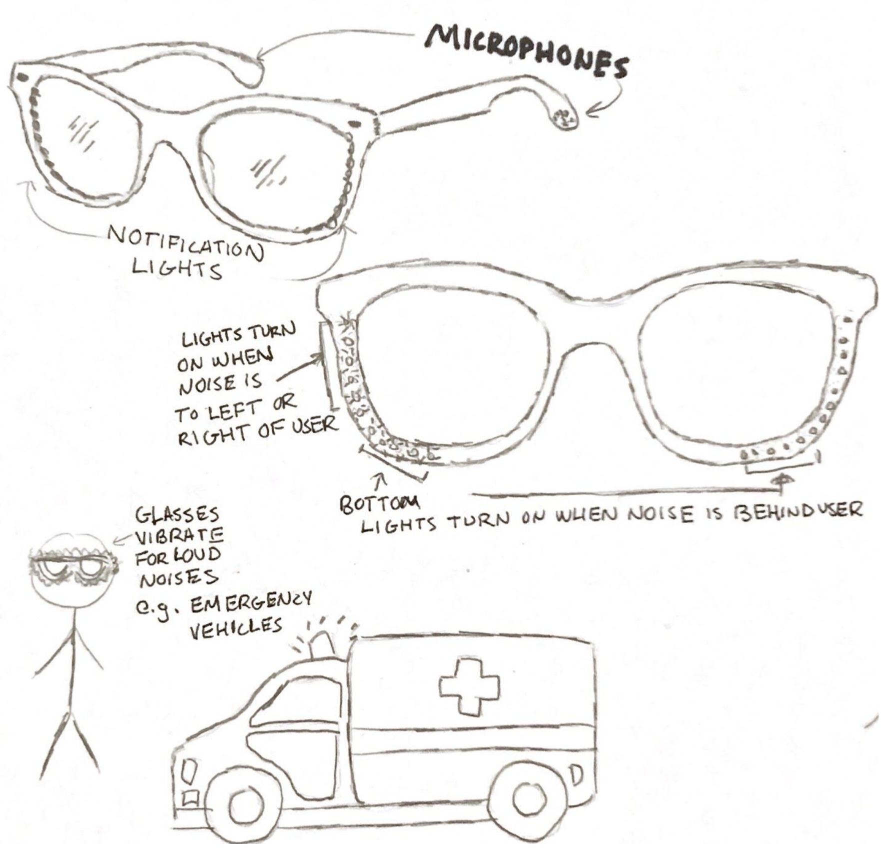
- The lighting system allows the user to be notified of bikers trying to pass

Inform drivers that an emergency vehicle is approaching. (2)

- The vibration feature will inform the user of noises from emergency vehicles.

Alert user of loud noises when walking (6)

- Other information such as dog barks and car horns will generate a similar alerts.



Mobile Application | Proposed Design 3

Description

This design is for a mobile application that automatically alerts the user to pertinent information based on their location. A user's phone would vibrate and send a notification for the relevant information. The app would allow the user to opt into notifications that they would like to receive, allowing them to customize it to fit their needs. One possible opt-in strategy is to use Quick Response (QR) codes, where the notifications can be customized, much like email preferences for multiple mailing lists. Some potential use cases include airports, bus or train, ride-sharing, and retail stores to name a few. At an airport the user could get pre-flight announcements according to their itinerary. The application could also use speech-to-text in order to relay in-flight announcements. While commuting by bus or train, the user could get GPS-based notifications about current and future stops according to their preferences. The user could also enroll at a supporting retail store, where intercom announcements can be relayed. Finally loud noises would also generate their own alert so the user when could be notified of loud environmental noises.

Tasks Supported

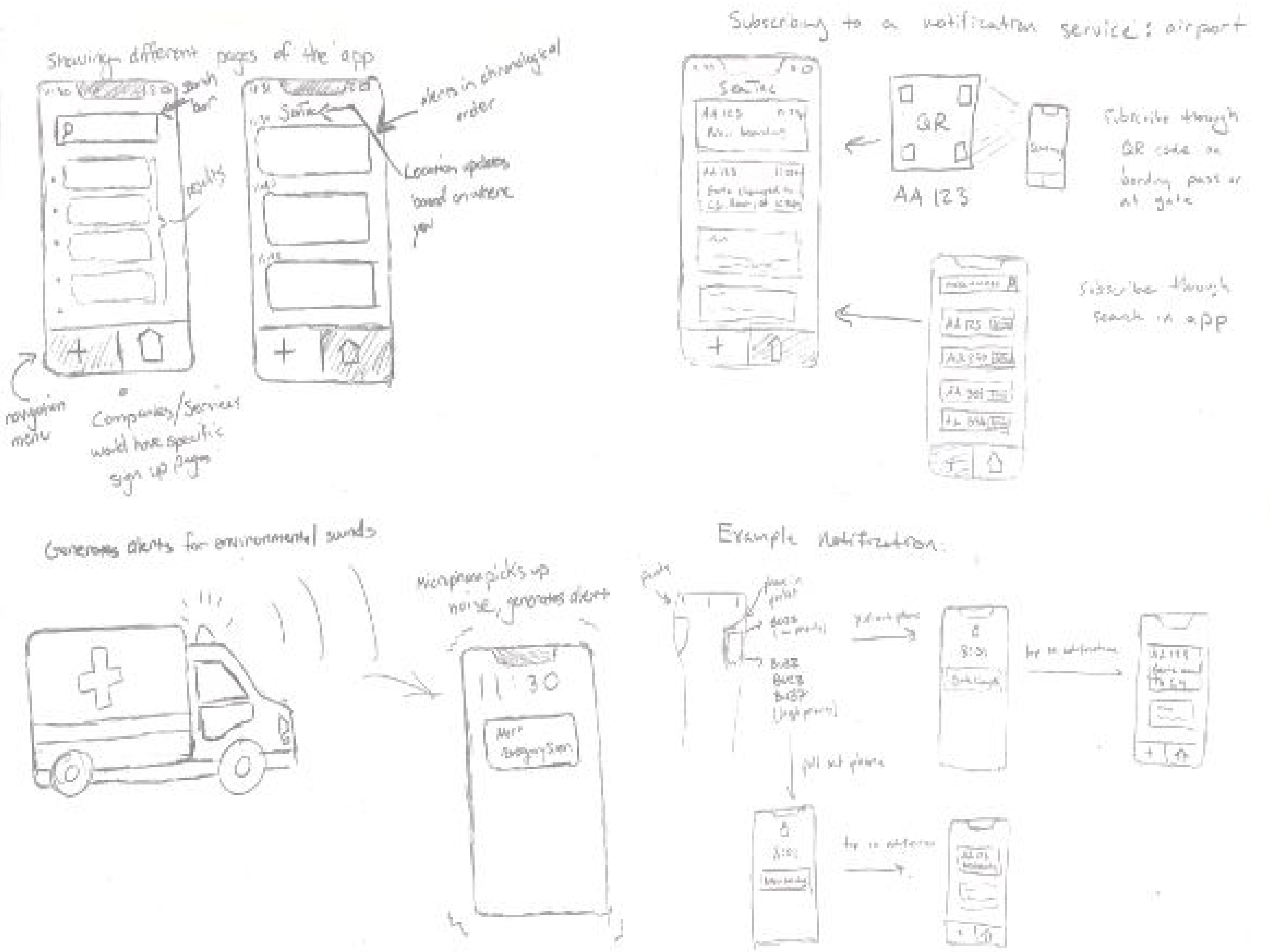
Notify passengers of in-flight and terminal announcements (5)
- Get push notifications with pre-flight announcements.
- Get push notifications with in-flight announcements

Departing the bus at the correct stop. (3)
- GPS-based push notifications for current and next stop

Commuting via taxi or on-demand car service.
- GPS-based push notification indicating the vehicle is close
- Alert the driver to their passenger's hearing

Alert user of loud noises while walking (6)
- App generates app based on environmental sounds and alerts user

Sketches


Showing different pages of the app
alerts in chronological order
Location updates based on where you
navigation menu
Companies/Services would have specific sign up pages
Subscribing to a notification service: airport
QR
AA 123
Subscribe through QR code on boarding pass or at gate
Subscribe through search in app
Generates alerts for environmental sounds
Microphone picks up noise, generates alert
11:30
Example Notification:

AuVi | Refined Design

We decided to focus on a mix of our attachable design with a wearable notifier. AuVi consists of two items: the sensors from the attachable design with an optical display on glasses. The sensors detect audio and visual information, while the glasses present the information in a stereoscopic, user-friendly form.

The Sensors

The sensors will come in pairs. They will be attachable to many different types of items, such as backpacks, bicycles, and car bumpers. The sensor will collect and relay information for display to the user. The sensors will automatically pair with the glasses to relay the audible information seamlessly.

The Glasses

The glasses will feature a display surrounding the peripheral of the lens. They will light up directionally depending on where the sensors locate the sound. Lighting on the left and right of the lense correspond to noises on the left and right respectively. Lighting on the bottom correspond to noises directly behind. The glasses also vibrate to notify the user that there is an emergency vehicle approaching.

Our Design's Key Tasks

- Notify bikers and drivers when someone is trying to pass them.
- Informing a driver that an emergency vehicle is approaching.

Why this design?

We chose this design because it allowed us to address the two key tasks that address the major complaints expressed by our research participants. By picking these tasks as our focus, we can better address the needs they expressed and make them safer on bike paths and roads. One of the reasons we went with this design was that it allows for the same interface to be used in multiple, unique, and important situations. This is important because environmental sounds are crucial for safety in every mode of transport.

Why is this design suited to our target group?

Our proposed design is better suited for our target group because the design bridges the information gap that deaf people experience; it maps imperceptible audible signals to perceptible visual signals. Our design will make users feel more comfortable in their commuting environment by alerting them to environmental sounds they otherwise would have missed.

Why are these tasks more compelling than the others?

These tasks were explicitly identified by our participants as being their biggest concerns. Additionally, we believe notifying commuters of other their surroundings will benefit our target group and the general population by keeping them safer and more informed of their surroundings. While the design is primarily intended for the deaf and hard of hearing, a notification system can also be useful for commuters who have an artificial hearing impairment (e.g. headphones, noise pollution). This will improve users safety during their daily navigation.

Written Scenarios - “1x2”

Bill The Biker | Scenario 1

Bill is commuting by bicycle (Figure A) when another biker behind him shouts “on your left!” to indicate the desire to pass on Bill’s left. Bill is happy to share the road, but he cannot hear the other biker calling out because of his hearing loss, despite his hearing aids. Thankfully he has AuVi, which notifies him that there’s a biker approaching from behind him on his left. Bob takes a quick look over his shoulder and see’s the happy biker trying to pass him. Bob happily pulls over to right side of the road and lets the other biker by. AuVi notifies Bob when someone is behind him and making noises to try to pass him so that he can move over to let them pass safely.

Sandy The Soccer Mom | Scenario 2

Sandy, a soccer mom who suffers from hearing loss, is taking her two daughters to their weekly practice across town (Figure B). While she is driving, an ambulance races towards her from behind. Sandy can’t hear its siren. Her daughters, who can hear are busy catching up with last weekends Saturday morning cartoons. Sandy’s new AuVi glasses alert her that its sensors have detected and of the siren over her left shoulder. She quickly locates the emergency vehicle and pulls over, allowing it to pass safely.

Storyboards

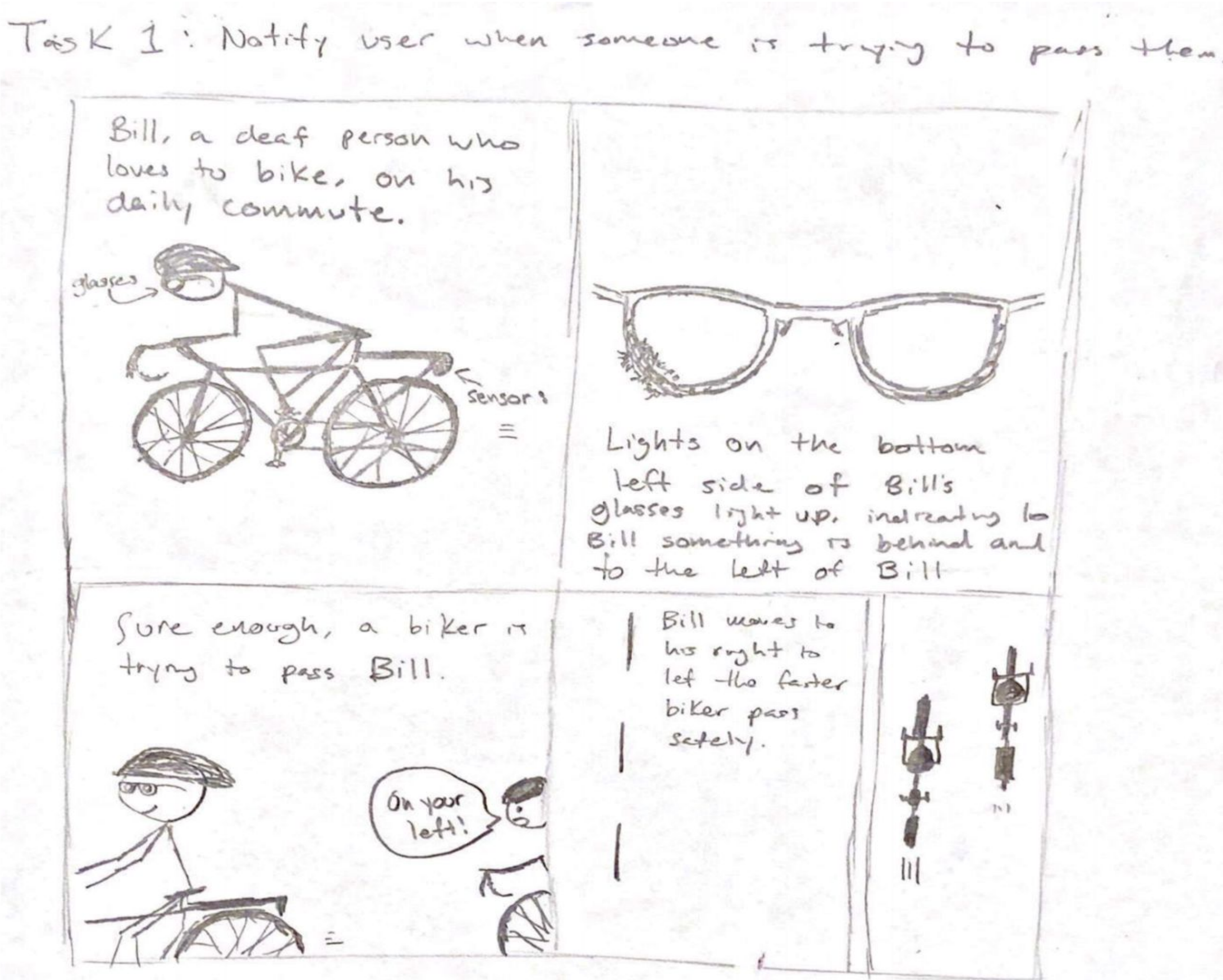


Figure A : Notifying biker of another biker trying to pass them

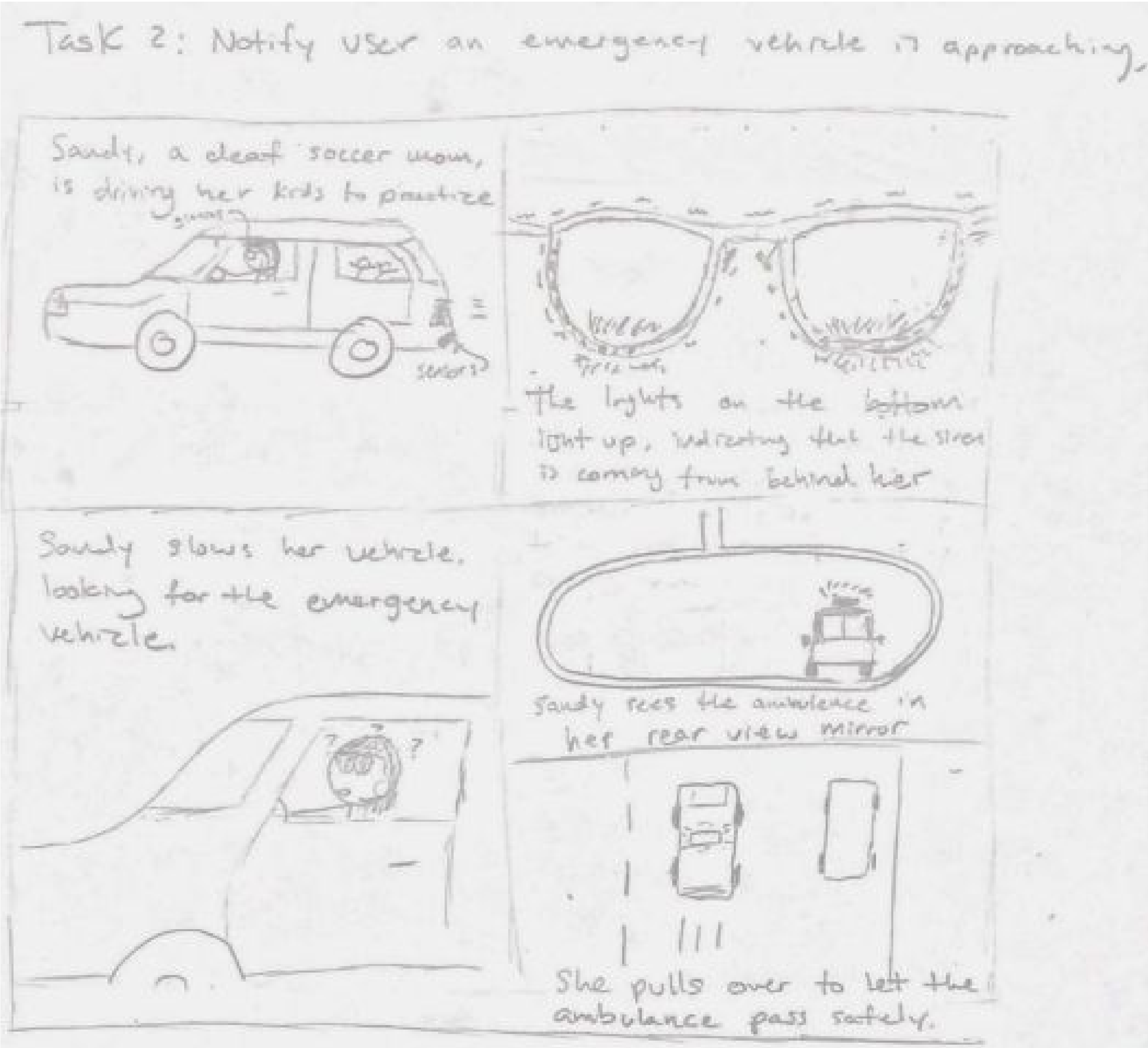


Figure B : Informing drivers of emergency sirens